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ABSTRACT

This document presents highlights from the 1996 National Assessment of Educational Progress (NAEP) Science Assessment for grades 4, 8, and 12. This is the premier issue of a series aimed at bringing these test results to a broader audience. Results are presented through easy-to-understand graphs and examples of test questions with student answers. Student performance is measured against the standards set by the NAEP governing board. The Proficient level is central, defining solid performance that demonstrates competency over challenging subject matter. The Basic level means partial mastery of fundamental knowledge and skills. The Advanced level signifies superior performance. Achievement levels are defined in detail for each age group. The 1996 NAEP Science Assessment contains: (1) multiple-choice questions that assess student knowledge of important facts and concepts and probe their analytical reasoning; (2) short and long written response questions that measure student ability to explain, integrate, apply, analyze, evaluate, and communicate scientific information; and (3) hands-on activities that probe student ability to make observations, perform investigations, and evaluate and apply results of investigations. Test data are combined and reported on both national and state levels. (PVD)

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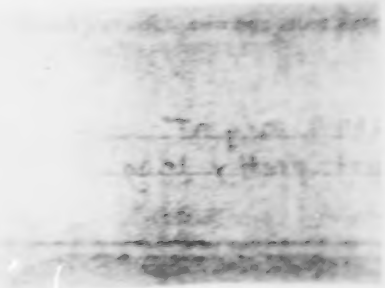
ED 414 200

What Students Know?

1996 NAEP Science Results for 4th, 8th, & 12th Graders



A Message From the National Assessment Governing Board

As citizens grapple with improving their schools, the information they want from achievement tests is changing. No longer is it enough to compare who's high and who's low on an exam. What we really want to know is: Just how good is "good enough?" One of the best ways to get a fix on that key question is to gauge student achievement against performance standards, which describe what students should know and be able to do at different grade levels.

Since 1988, the National Assessment Governing Board (NAGB) has been required by law to set performance standards, called achievement levels, for the National Assessment of Educational Progress (NAEP). Based on a national sample of students, NAEP is the nation's leading indicator of what students know and can do in mathematics, science, reading, U.S. history, world geography, and other subjects. *What Do Students Know?* presents highlights from the 1996 NAEP Science Assessment for grades 4, 8, and 12.

What Do Students Know? is the first publication of its kind – the premier issue of a series aimed at bringing these valuable test results to a broader audience. We present the results through easy-to-understand graphs and examples of test questions with student answers. In the following pages, you will see performance of students measured against standards set by the Board. The *Proficient* level is central, defining solid performance that demonstrates "competency over challenging subject matter." The *Basic* level means partial mastery of fundamental knowledge and skills. The *Advanced* level signifies superior performance.

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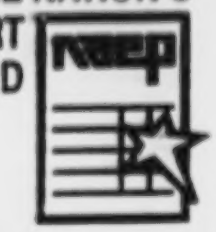
The Questions

The 1996 National Assessment of Educational Progress (NAEP) Science Assessment includes different kinds of questions for students:

- Multiple-choice questions that assess students' knowledge of important facts and concepts and that probe their analytical reasoning.
- Short and long written response questions that measure students' abilities to explain, integrate, apply, analyze, evaluate, and communicate scientific information.
- Hands-on activities that probe students' abilities to make observations, perform investigations, and evaluate and apply results of investigations.

THE NATION'S REPORT CARD



National Assessment Governing Board
U.S. Department of Education

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Our aim is to make national assessment results more understandable, the spark that will ignite a national conversation about how science is taught and learned in the nation's schools. We hope *What Do Students Know?* helps you begin to answer the questions "How close are we to achieving the standards?" and "How can we do better?"

William T. Randall, Chair
National Assessment Governing Board

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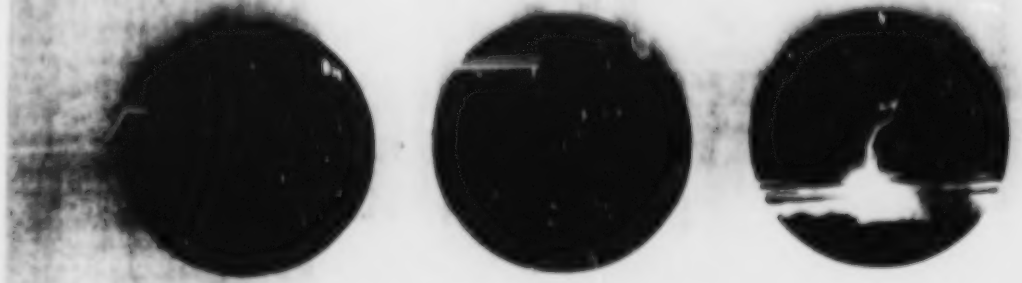

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Science Sampler

Examples of NAEP Questions

Questions on the National Assessment of Educational Progress cover a wide range of formats – multiple choice, short answer, long answer, and science activities. The following sampling of questions gives a flavor of the kinds of information the test covers and how students performing at different achievement levels respond.

What's the Score?

In 1996, science assessment students spent about 80 percent of their time answering questions which required a written answer. These kinds of questions are not scored just "right" or "wrong." Rather, students are given some credit for partially correct (less complete) answers, and full credit for the best or most complete answers. In giving students credit, scorers only look at the science content of the answer.

[illegible]rade

Basic Level - Sample Question

Students at the Basic level are likely to offer one useful property – not two – of common household materials such as metal.

Many things are made of metal, such as pots, pans, tools, and wire. Give two reasons why metals are used to make many different things.

I think one reason might be because metal last pretty long

Scoring guide:

2 = Lists 2 properties of metal
1 = Lists 1 property of metal
0 = Lists no properties of metal

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What do the achievement levels mean?

Grade 4

BASIC -
Partial Mastery

Students performing at the Basic level demonstrate some of the knowledge and reasoning required for understanding of the earth, physical, and life sciences at a level appropriate to Grade 4. For example, they can carry out simple investigations and read uncomplicated graphs and diagrams. Students at this level also show a beginning understanding of classification, simple relationships, and energy.

- PROFICIENT -
Solid Performance

Students performing at the Proficient level demonstrate the knowledge and reasoning required for understanding of the earth, physical, and life sciences at a level appropriate to Grade 4. For example, they understand concepts relating to the Earth's features, physical properties, and structure and function. In addition, students can formulate solutions to familiar problems as well as show a beginning awareness of issues associated with technology.

ADVANCED -
Superior Performance

Students performing at the Advanced level demonstrate a solid understanding of the earth, physical, and life sciences as well as the ability to apply their understanding to practical situations at a level appropriate to Grade 4. For example, they can perform and critique simple investigations, make connections from one or more of the sciences to predict or conclude, and apply fundamental concepts to practical applications.

3B

Grade

Proficient Level - Sample Question

This question measures the students' understanding of how natural forces change features of the Earth's surface and the ability to describe those changes. At the Proficient level, students are likely to respond with partial answers—one or two forces—and they may or may not be able to describe the changes.

Scoring guide:

- 3 = Lists 2 forces and 2 descriptions
- 2 = Lists 2 forces and 1 description
- 1 = Lists 1 force and 1 description or lists 1 or 2 forces with no descriptions
- 0 = Lists no correct forces

Natural forces are always changing features of the Earth's surface. Some changes happen quickly and some changes happen slowly.

(a) Name one natural force that can change a part of the Earth's surface over a period of days.

tornado

How is the Earth's surface changed?

it changed when big things happend

(b) Name one natural force that can change a part of the Earth's surface over a period of hundreds of years.

Water

How is the Earth's surface changed?

Percentage of students at the Proficient level receiving a score of 1:

64%

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3C

Grade

Advanced Level - Sample Question

Most students at the Advanced level demonstrate a full understanding of the life cycle of familiar organisms.

The picture below shows the life cycle of a grasshopper.

Tell one way that the grasshopper's life cycle is different from the butterfly's life cycle.

Because all of its
r look the same but
it just gratts bigger Other
than the butterfly it changes
the way it looks.

Tell one way that the grasshopper's life cycle is the same as the butterfly's life cycle.

Both of them are
eggs first. They also
go through many
stages

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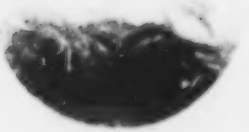
Scoring guide:

- 4 = Lists 2 similarities and 2 differences
- 3 = Lists 2 differences and 1 similarity or 2 similarities and 1 difference
- 2 = Lists 1 similarity and 1 difference or 2 similarities or 2 differences
- 1 = Lists 1 similarity or 1 difference
- 0 = Lists no correct similarities or differences

Tell some other ways that the grasshopper's and the butterfly's life cycles are similar and different from each other.

The way that they are similar is that they both turn to bigger minds. they are a egg first and both have antlers. they are different by the grasshopper has more stages to go through the butterfly is first a catepiller then it turns into a cocoon.



Percentage of students at the Advanced level receiving a score of 3:

Note: 4 percent of students at the advanced level received a score of 4.

What Fourth Graders Know and Are Able to Do

4B

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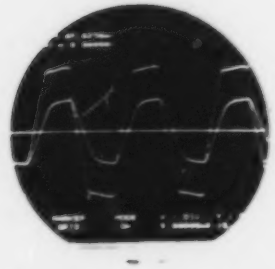
Advanced Level

- Explain the temperature effect on buckets of water
- Identify items which conduct electricity
- Identify an appropriate experimental design
- Explain the relationship between climate and house construction
- Identify which graph represents the result of eggs from a toad

4C



Grade

Basic and Proficient Levels - Sample Question

At the Basic level, students would probably be able to respond correctly to one part of the following question, while those at the Proficient level are likely to be able to read a graph and make an observation about the data displayed and offer an explanation for the observation.

Scoring guide:

2 = Identifies Mercury and Venus and explains the procedure

1 = Identifies 1 or both planets and may or may not give the correct explanation

0 = Identifies Mars

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What do the achievement levels mean?

Grade 8

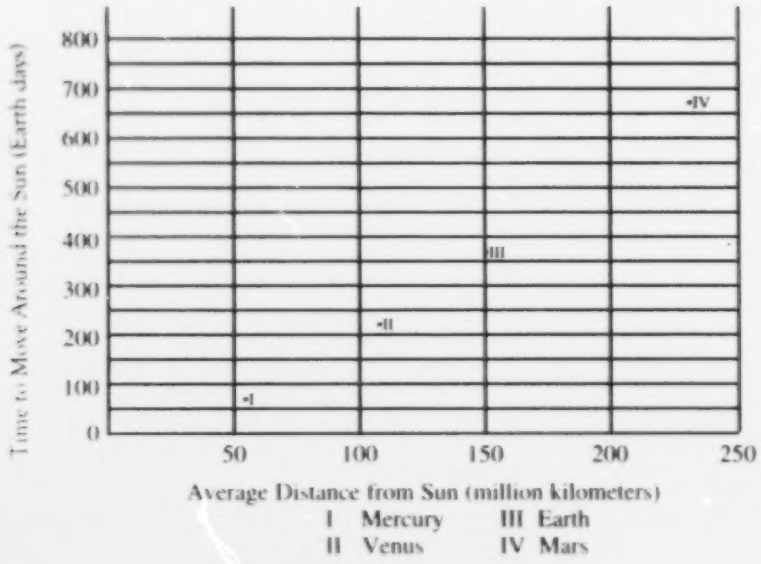
BASIC -
Partial Mastery

Students performing at the Basic level demonstrate some of the knowledge and reasoning required for understanding of the earth, physical, and life sciences at a level appropriate to Grade 8. For example, they can carry out investigations and obtain information from graphs, diagrams, and tables. In addition, they demonstrate some understanding of concepts relating to the solar system and relative motion. Students at this level also have a beginning understanding of cause-and-effect relationships.

PROFICIENT -
Solid Performance

Students performing at the Proficient level demonstrate much of the knowledge and many of the reasoning abilities essential for understanding of the earth, physical, and life sciences at a level appropriate to Grade 8. For example, students can interpret graphic information, design simple investigations, and explain such scientific concepts as energy transfer. Students at this level also show an awareness of environmental issues, especially those addressing energy and pollution.

The planets move at different speeds and require different amounts of time to circle the Sun. The following graph shows the number of Earth days it takes for each of the four planets to move around the Sun once.



Using information from the graph, name each planet that has a year that is shorter than a year on Earth. Explain how you arrived at your answer.

Mercury and Venus

Percentage of students at the Basic level receiving a score of 1:

73%

1

5B

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ADVANCED -
Superior Performance

Students performing at the Advanced level demonstrate a solid understanding of the earth, physical, and life sciences as well as the abilities required to apply their understanding in practical situations at a level appropriate to Grade 8. For example, students can perform and critique the design of investigations, relate scientific concepts to each other, explain their reasoning, and discuss the impact of human activities on the environment.

Using information from the graph, name each planet that has a year that is shorter than a year on Earth. Explain how you arrived at your answer.

The planets of Venus and Mercury have a shorter year than an earth year because it takes them less time than 365 days to orbit the sun

Percentage of students at the Proficient level receiving a score of 2:

70%

5C

Grade

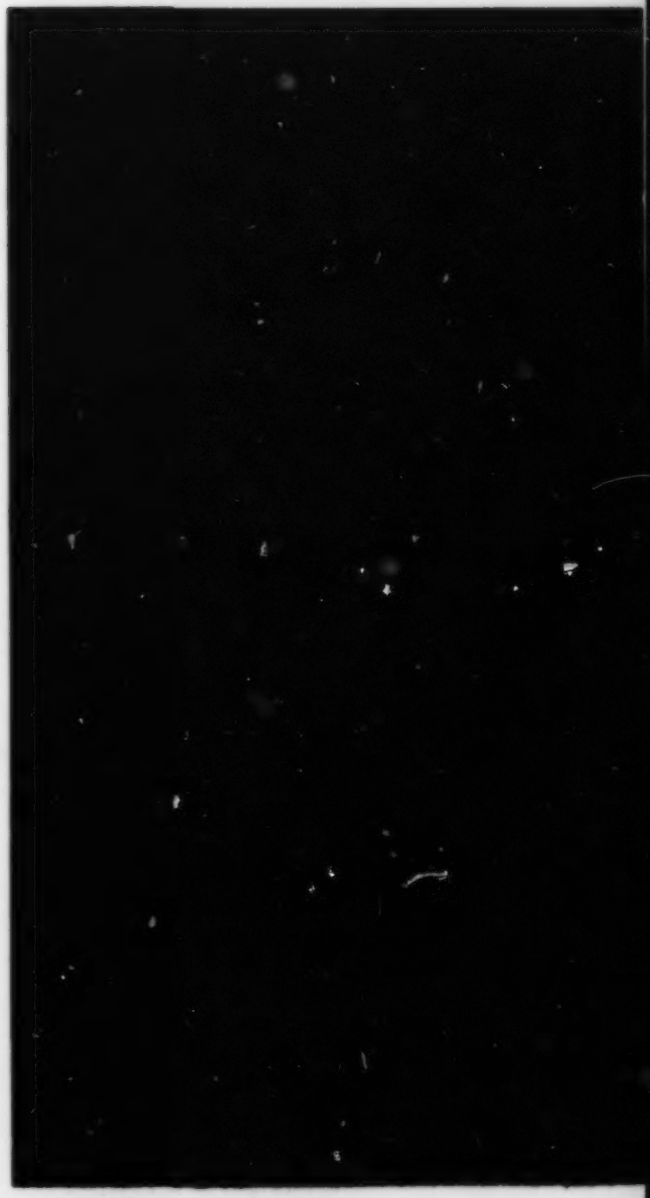
Advanced Level - Sample Question

This multiple-choice question measures the students' understanding of input/output energy forms. Students at the Advanced level are likely to choose the correct response.

Which of the following represents the input/output energy forms for a stereo system?

	Input	Output
A	Motion	Sound only
B	Motion	Sound and heat only
C	Electricity	Motion and sound only
●	Electricity	Motion, sound, and heat

Percentage of students at the Advanced level answering correctly



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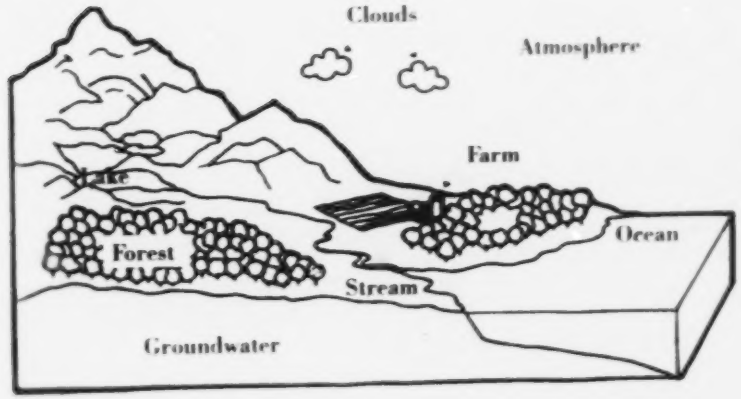
Basic Level - Sample Question

Students at the Basic level understand most, but not all, of the elements that occur during water cycles.



The diagram above shows a region near the coast of a large continent. A range of high, snowcapped mountains lies near the ocean. There is a farm between the mountains and a forest.

The following question asks you to think about water and the water cycle in the system shown in the diagram. In the system, water exists as a gas, a liquid, and a solid.

Describe how water in the lake can become snow on the mountains in the system shown in the diagram.

The lake water can be evaporated in as gaseous form. And percipitate into clouds the clouds will then hold so much combustion, that it would bring forth snowflakes

Scoring guide:

3 = Lists 3 elements of the process in this water cycle
2 = Lists 2 elements
1 = Lists 1 element
0 = Shows no understanding

Percentage of students at the Basic level receiving a score of 2:

77%

5

6B

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6C

What Twelfth Graders Know and Are Able to Do

What do the achievement levels mean?

Grade 12

BASIC - Partial Mastery

Students performing at the Basic level demonstrate some knowledge and certain reasoning abilities required for understanding of the earth, physical, and life sciences at a level appropriate to Grade 12. In addition, they demonstrate knowledge of the themes of science (models, systems, patterns of change) required for understanding the most basic relationships among the earth, physical, and life sciences. They are able to conduct investigations, critique the design of investigations, and demonstrate a rudimentary understanding of scientific

7

Grade 12 Proficient and Advanced Levels - Sample Question

At the Proficient level, students are likely to provide only one portion of a full response to the following questions on energy transformations in technological systems. Students at the Advanced level demonstrate a full understanding and can explain differences among the energy transformations.

Coal is burned in a power plant that produces electricity. In a house miles away, a lightbulb is turned on. Describe the energy transformations involved.

COAL BEING BURNED GIVES OFF HEAT, WHICH GIVES OFF ENERGY.

Compare the amount of energy released in one hour by burning the coal, the amount of energy received from the power plant in one hour by the house, and the amount of light energy produced in one hour by the lightbulb. Explain any differences among these three amounts of energy..

THE AMOUNT OF ENERGY RELEASED IN 1 HOUR BY BURNING THE COAL IS MUCH MORE THAN THE AMOUNT OF ENERGY RECEIVED FROM THE POWERPLANT IN ONE HOUR BY THE HOUSE WHICH IS MORE THAN THE AMOUNT OF LIGHT ENERGY PRODUCED ONE HOUR BY THE LIGHTBULB. ALL THIS BECAUSE EACH TIME IS PASSED, LOSES ENERGY

Percentage of

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7A

patterns of change) required for understanding the most basic relationships among the earth, physical, and life sciences. They are able to conduct investigations, critique the design of investigations, and demonstrate a rudimentary understanding of scientific principles.

PROFICIENT - Solid Performance

Students performing at the Proficient level demonstrate the knowledge and reasoning abilities required for understanding of the earth, physical, and life sciences at a level appropriate to Grade 12. In addition, they demonstrate knowledge of the themes of science (models, systems, patterns of change) required for understanding how these themes illustrate essential relationships among the earth, physical, and life sciences. They are able to analyze data and apply scientific principles to everyday situations.

ADVANCED - Superior Performance

Students performing at the Advanced level demonstrate the knowledge and reasoning abilities required for a solid understanding of the earth, physical, and life sciences at a level appropriate to Grade 12. In addition, they demonstrate knowledge of the themes of science (models, systems, patterns of change) required for integrating knowledge and understanding of scientific principles from the earth, physical, and life sciences. Students can design investigations that answer questions about real-world situations and use their reasoning abilities to make predictions.

transformations in technological systems. Students at the Advanced level demonstrate a full understanding and can explain differences among the energy transformations.

The is House, light energy

Percentage of students at the Proficient level receiving a score of 1:

67%

Coal is burned in a power plant that produces electricity. In a house miles away, a lightbulb is turned on. Describe the energy transformations involved.

The heat from the coal is transformed to electricity in the light, which transforms into light energy.

Compare the amount of energy released in one hour by burning the coal, the amount of energy received from the power plant in one hour by the house, and the amount of light energy produced in one hour by the lightbulb. Explain any differences among these three amounts of energy.

The amount of energy recieved by the house is less than produced by powering the coal, because some of the heat is lost. The lightbulb produces less than received by the house because the lightbulb is probably not the only uses of electricity in the house.

Scoring guide:

3 = Lists 3 elements of energy transformations
2 = Lists 2 elements
1 = Lists 1 element
0 = Lists no correct elements

Percentage of students at the Advanced level receiving a score of 3:

57%

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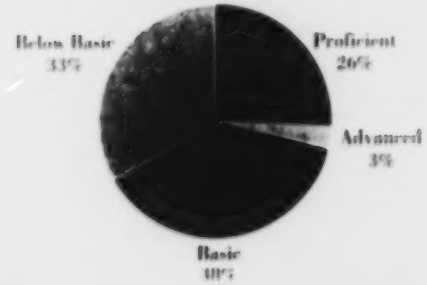
7C

NAEP Highlights

Spotlight on the Nation provides achievement results for public and non-public school students in 4th, 8th, and 12th grades.

- 3 percent of the nation's 4th, 8th, and 12th graders reached the Advanced level
- 26 percent of 4th and 8th graders and 18 percent of 12th graders performed at the Proficient level
- 38 percent of 4th graders; 32 percent of 8th graders; and 36 percent of 12th graders performed at the Basic level
- Grade 4: greater percentages of males than females were at or above the Proficient level. Grade 8: approximately the same percentage of males and females reached each achievement level. Grade 12: males performed better than females at all three achievement levels.

Grade 4



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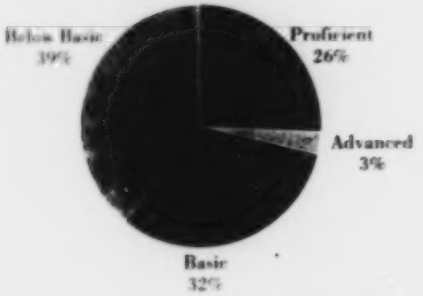
Spotlight on the Nation

Table 1

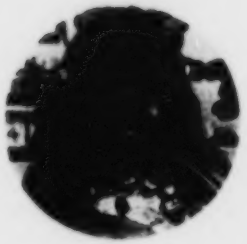
Percentage attaining science achievement levels by race/ethnicity

	Advanced	Proficient	Basic	Below Basic
Grade 4				
All Students	3	26	38	33
White	4	33	42	21
Black	0	7	27	66
Hispanic	0	9	33	58
Asian/Pacific Islander	4	25	37	34
American Indian	2	24	33	41
Grade 8				
All Students	3	26	32	39
White	4	33	36	27
Black	0	5	19	76
Hispanic	0	11	25	64
Asian/Pacific Islander	3	27	32	38
American Indian	2	22	36	40
Grade 12				
All Students	3	18	36	43
White	3	24	41	32
Black	0	4	19	77
Hispanic	1	6	26	67
Asian/Pacific Islander	3	19	34	44

Grade 8



Grade 12



Grade 12				
All Students	3	18	36	43
White	3	24	41	32
Black	0	4	19	77
Hispanic	1	6	26	67
Asian/Pacific Islander	3	19	34	44
American Indian	0	10	42	48

SOURCE: National Center for Education Statistics, National Assessment of Educational Progress (NAEP), 1996 Science Assessment

Table 2

Percentage attaining science achievement levels by gender

	Advanced	Proficient	Basic	Below Basic
Grade 4				
All Students	3	26	38	33
Male	3	28	37	32
Female	3	24	40	33
Grade 8				
All Students	3	26	32	39
Male	4	27	31	38
Female	3	24	34	39
Grade 12				
All Students	3	18	36	43
Male	4	21	35	40
Female	1	16	38	45

SOURCE: National Center for Education Statistics, National Assessment of Educational Progress (NAEP), 1996 Science Assessment

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Spotlight on the States

Percentages of students at or above Proficient are higher than the nation

Percentages of students at or above Proficient are not significantly different from the nation

Percentages of students at or above Proficient are lower than the nation

Did not participate

Note: Department of Defense Dependents Schools (Overseas) (DoDDS) percentages are higher than the nation; Department of Defense Domestic Dependents Schools (DDESS) percentages are not significantly different from the nation.

Spotlight on the States provides achievement results for public school students in the nation and participating states. This chart contains achievement level data for 40 states, the District of Columbia, Guam, and Department of Defense schools, both overseas (DoDDS) and domestic (DDESS). Not all states appear because some elected not to participate in NAEP, and others failed to satisfy all criteria (*).

Grade 8 State NAEP Science Assessment

Percentage of Students at Each Achievement Level

U.S. Public Schools	10	44	24	3
Alabama	54	29	17	1
Alaska*	35	37	28	3
Arizona	45	31	24	2
Arkansas*	45	34	21	1
California	53	28	19	1
Colorado	32	38	30	2
Connecticut	32	35	33	3
Delaware	39	40	20	1
District of Columbia				

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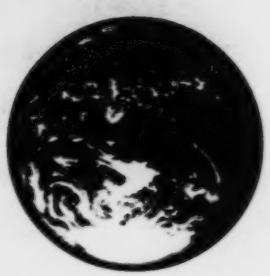
achievement level data for 40 states, the District of Columbia, Guam, and Department of Defense schools, both overseas (DoDDS) and domestic (DDESS). Not all states appear because some elected not to participate in NAEP, and others failed to satisfy all criteria (*).



For further information, contact:
National Assessment Governing Board
800 North Capitol St. NW
Suite 825
Washington, DC 20002-4233

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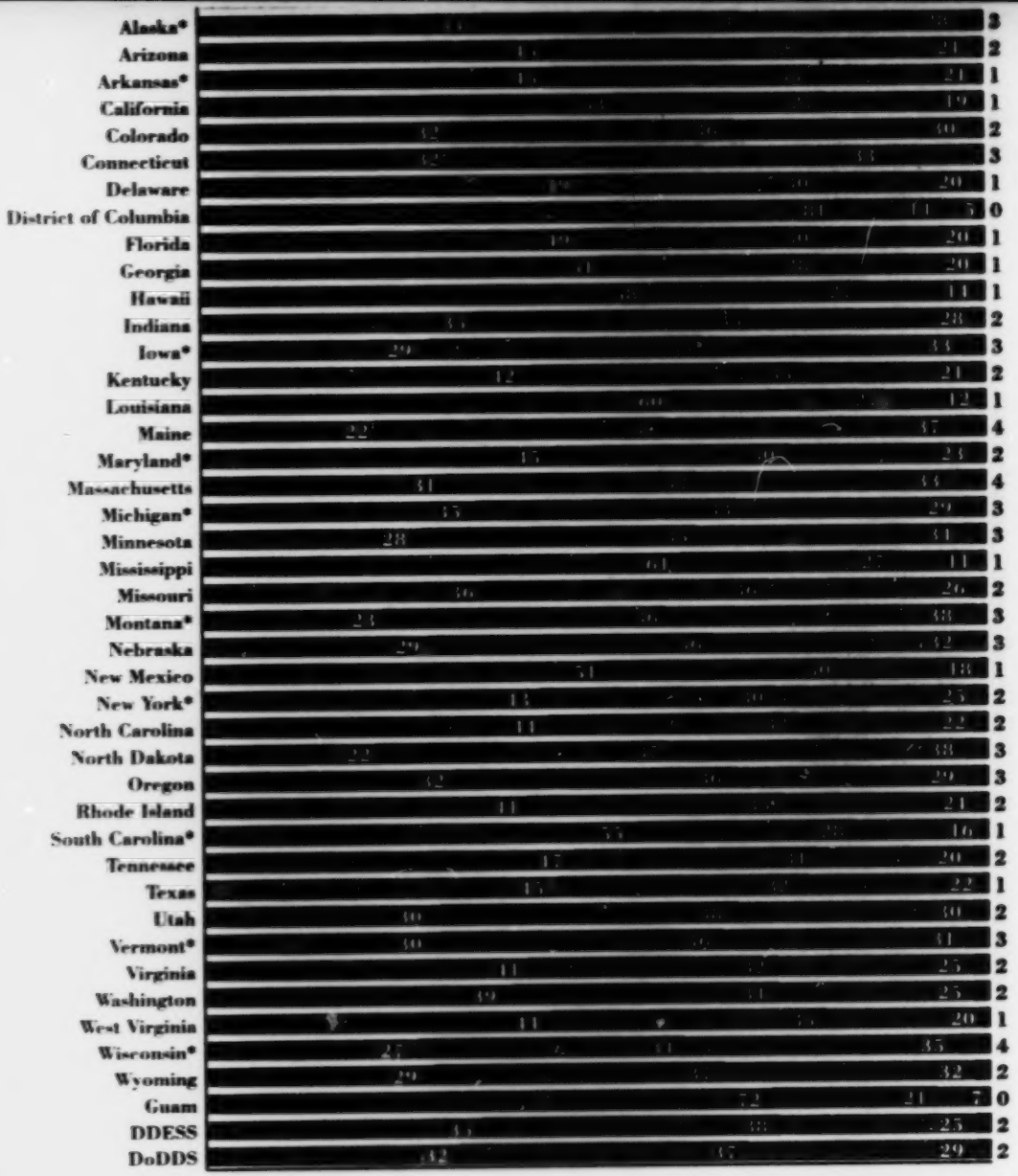

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